Session: Integration and management of the electricity grid: some experiences

Presentation: Electricity Distributor Productivity in and Evolving Electricity Landscape

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Overview

- Ontario electricity distributors have been under incentive regulation for about 25 years.

- The Ontario Energy Board (OEB) uses data-driven methods to evaluate their performance and to set rates.

Overview

- The energy transition has complicated the data analysis process as the roles and responsibilities of distributors have evolved.

- This paper uses multiple methodologies to analyse an extensive dataset on Ontario distributors for the period 2002-2022. There is considerable variation in the measured efficiency of electricity distributors.

Annual Rate Adjustment Formula

- Price Cap = Inflation Factor – Productivity Factor – Stretch Factor
  - **Inflation Factor**: Reflects economy-wide cost changes (based on inflation indices).
  - **Productivity Factor (X-factor)**: Informed by Total Cost Benchmarking (TCB) model trend term and TFP modeling.
  - **Stretch Factor**: A utility-specific efficiency requirement based on its performance ranking (more efficient utilities get a lower stretch factor and vice-versa). Based on TCB model.

- Five years cycle

- Yardstick competition but also ‘Custom Incentive Regulation’

Methods

- We use four methods to analyse productivity
  - total cost benchmarking (TCB),
  - total factor productivity (TFP),
  - data envelopment analysis (DEA), and
  - stochastic frontier analysis (SFA).

TCB implementation

- Output variables :
  - number of customers,
  - distribution capacity
  - electricity deliveries
  - network line length

- Input variables include
  - factor prices (OM&A and capital)
  - utility specific factors
    - customer density,
    - age of assets,
    - underground v. overhead wires,
    - EV stations
    - DER penetration
    - time trend

Methods

- The TFP implementation does not account for covariates. It follows the usual approach of comparing aggregate output and input indexes.
- SFA includes an explicit productivity trend term and utility specific factors.
- Various versions of DEA are implemented, the main variables being outputs and inputs.

Overview of Results

- Consistent with previous analyses of Ontario data covering earlier periods, most of our modelling estimates find *negative or very slightly positive* measured productivity growth
- However, the productivity growth is less negative during the latter part of the dataset (2013-2022). This suggests that the incentive regulation scheme which the OEB implemented in 2013 has had a beneficial effect.
- It should be emphasized that negative values may be a consequence of modelling limitations arising from the absence of data on the changing roles and responsibilities of utilities.

Data Development

- To compare data from 2002-2012 and 2013-2022, we create a balanced panel.

- Many mergers and amalgamations of distributors have occurred in Ontario. The number of distributors used in benchmarking has declined from 73 to 54.

Total Cost Benchmarking Results (MS)

- Econometric Model Results

2002-2012	Coefficient	Standard Error	t-statistic	p-value	2013-2022	Coefficient	Standard Error	t-statistic	p-value
Constant	12.9085	0.0249	518.2911	0.00	**Constant**	13.1338	0.0278	473.0940	0.00
WK	0.6178	0.0081	76.4991	0.00	**WK**	0.5939	0.0079	74.9936	0.00
N	0.5983	0.0812	7.3660	0.00	**N**	0.7084	0.1111	6.3776	0.00
C	0.2114	0.0788	2.6834	0.01	**C**	-0.2336	0.1176	-1.9861	0.05
D	0.0951	0.0433	2.1979	0.03	**D**	0.2867	0.0826	3.4717	0.00
WKWK	0.0223	0.0222	1.0064	0.31	**WKWK**	0.1162	0.0135	8.5907	0.00
NN	-0.2893	0.2943	-0.9832	0.33	**NN**	-0.0939	0.4133	-0.2272	0.82
CC	-0.0137	0.2320	-0.0592	0.95	**CC**	0.5534	0.4291	1.2897	0.20
DD	-0.0583	0.0880	-0.6623	0.51	**DD**	0.3888	0.3093	1.2569	0.21
WKN	0.0731	0.0170	4.2926	0.00	**WKN**	0.1564	0.0261	5.9930	0.00
WKC	-0.0176	0.0153	-1.1481	0.25	**WKC**	-0.1070	0.0270	-3.9673	0.00
WKD	-0.0023	0.0069	-0.3387	0.73	**WKD**	0.0080	0.0136	0.5872	0.56
NC	0.0873	0.2375	0.3676	0.71	**NC**	-0.0318	0.3369	-0.0943	0.92
ND	0.0893	0.1298	0.6876	0.49	**ND**	0.0947	0.2774	0.3413	0.73
CD	0.0183	0.0880	0.2077	0.84	**CD**	-0.4818	0.2976	-1.6190	0.11
L	0.1202	0.0188	6.3967	0.00	**L**	0.2149	0.0215	9.9856	0.00
NG	0.0227	0.0110	2.0594	0.04	**NG**	-0.0100	0.0131	-0.7588	0.45
Trend	0.0123	0.0018	6.9137	0.00	**Trend**	0.0048	0.0016	2.9804	0.00

Conclusions

- Our results underscore the need for a more nuanced approach to incentive regulation.
  - Distributors face evolving challenges, including managing distributed energy resources, modernizing equipment, installing and maintaining expanding electric vehicle charging infrastructure and adapting to changes in consumption patterns.
  - Estimation of productivity and efficiency using multiple methodologies can allow the regulator to better identify and decompose the sources of productivity change and incorporate these within more finely tuned distributor rates.
  - As has been noted by many observers, the evolving energy transition will continue to lead to changes in the roles and responsibilities of electricity distributors.

Conclusions

- Use of Total Cost Benchmarking (50+ utilities today) provides a statistically valid basis for comparison
  - Standardization of accounting improves comparability

- IR Implementation:
  - overall productivity trend term used to set X-factor;
  - Individual utility stretch factors determined by the extent to which a utility's actual costs are above or below TCB predicted costs

- Currently incorporating data on utilities from other jurisdictions